

PCT COOPERATION TREATY

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NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

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in its capacity as elected Office

Date of mailing (day/month/year) 27 July 2000 (27.07.00)	
International application No. PCT/BR99/00093	Applicant's or agent's file reference PE-3703
International filing date (day/month/year) 11 November 1999 (11.11.99)	Priority date (day/month/year) 12 November 1998 (12.11.98)
Applicant SCHWARZ, Marcos, Guilherme et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

10 June 2000 (10.06.00)

☐ in a notice effecting later election filed with the International Bureau on:
2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Pascal Piriou Telephone No.: (41-22) 338.83.38
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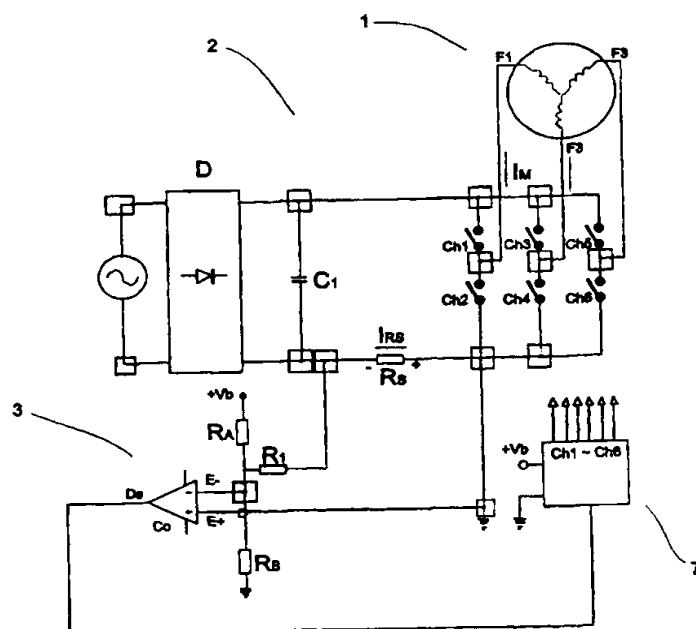
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : H02P		A2	(11) International Publication Number: WO 00/30243
			(43) International Publication Date: 25 May 2000 (25.05.00)
(21) International Application Number: PCT/BR99/00093 (22) International Filing Date: 11 November 1999 (11.11.99) (30) Priority Data: PI 9804608.0 12 November 1998 (12.11.98) BR (71) Applicant (for all designated States except US): EMPRESA BRASILEIRA DE COMPRESSORES S.A. - EMBRACO [BR/BR]; Rua Rui Barbosa, 1020, CEP-89219-901 Joinville, SC (BR). (72) Inventors; and (75) Inventors/Applicants (for US only): SCHWARZ, Marcos, Guilherme [BR/BR]; Rua General Osório, Conjunto Belvedere, 2, Joinville, SC (BR). DAINEZ, Paulo, Sérgio [BR/BR]; Bloco I, Apartment 302, Rua Rui Barbosa, 1431, Joinville, SC (BR). (74) Agent: DANNEMANN, SIEMSEN, BIGLER & IPANEMA MOREIRA; Rua Marquês de Olinda, 70, Caixa Postal 2142, Botafogo, CEP-22251-040 Rio de Janeiro, RJ (BR).		(81) Designated States: CN, JP, KR, SG, TR, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published Without international search report and to be republished upon receipt of that report.	

(54) Title: A SYSTEM AND A METHOD FOR PROTECTING AN ELECTRIC MOTOR AND ITS CONTROL CIRCUIT, AND AN ELECTRIC MOTOR

(57) Abstract

A system and a method for protecting electric motors and their respective control circuits are described, wherein it is possible to distinguish whether a situation of surge current results from an overload or from a short-circuit on the motor (1). This is achieved by means of a system for protecting an electric motor (1) and its control circuit (2), the motor speed control being carried out by means of a set of switches (Ch), the system comprising a control central (7) capable of measuring the electricity conduction time (T_c) of each of the switches (Ch) and to measure the time (T_d) passed between the beginning of conduction of one of the switches (Ch) and the occurrence of a surge current, the central (7) making a comparison of said times (T_d , T_c) and being capable of determining whether said surge current results from an overload or a short-circuit of the electric motor (1) or on one of the switches (Ch). The invention also refers to a method for protecting an electric motor (1) and its control circuit (2), the speed control of which is carried out by means of a set of switches (Ch), wherein the method comprises a step of measuring the electricity conduction time (T_c) of each of the switches (Ch), a step of measuring the time (T_d) passed between the beginning of conduction of one of the switches (Ch) and the occurrence of a surge current, and a step of comparing said times (T_d , T_c) and consequently determining whether said surge current results from an overload or from a short-circuit of the motor (1). In addition, the present invention refers to an electric motor (1) that is controlled by a set of switches (Ch), the control of the switches (Ch) being carried out by a control central (7) capable of measuring and comparing said times (T_d , T_c).



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**Title: "A SYSTEM AND A METHOD FOR PROTECTING AN ELECTRIC MOTOR AND ITS
CONTROL CIRCUIT, AND AN ELECTRIC MOTOR"**

The present invention refers to a system and method for protecting an electric
5 motor and its control circuit, which aims at detecting possible technical failures that cause
the current to rise.

An electric motor basically comprises a rotor and a stator. In order for this motor
to function, that is so say, for the rotor to start moving, voltage is applied to the stator, in-
ducing the movement of the rotor.

10 Usually, the control of rotation speed of the motor is carried out by means of
inverters, which in turn are formed from switches, as for instance a MOSFET (transistor).

The application of electric motors having controlled speed is widespread, being
used, for instance, for driving compressors, household appliances, traction, etc.

Basically, when used in permanent-magnet motors without position sensors,
15 the inverters are constituted by a set of diodes for branching the alternate voltage, from a
control central that actuates the switches and a block responsible for detecting the position
of the rotor by monitoring the voltages in the phases of motor, making a comparison be-
tween the monitored values. The control of the motor is carried out by modulating the volt-
age on the phase of the motor, which consists in applying and interrupting the voltage on the
20 phases at a high frequency. By means of this modulation, it is possible to control the current
supplied to said phases of the motor, and one can adjust it at the desired torque and speed
for its operation.

In the case of induction motors, the position detector of the rotor is not used, the control of speed and torque being effected by modulating the voltage on the phases of the motor.

5 In both cases, a control central is employed, which is usually constituted by a microcontroller or a signal processor, which receives the external command for operation of the motor and starting from the monitoring of internal variables of the motor/inverter (current on the motor, position of the rotor, etc.), generating commands that supply voltage and current to the motor.

10 During the actuation and functioning of the motor, the current may undergo rises (or surge current) as a result of a overload or else as a result of a short-circuit.

The rise of the current resulting from a overload does not immediately endanger the integrity of the motor and can be controlled. However, the current rise resulting from a short-circuit has a very rapid action, and so a protection mechanism should be actuated in order to prevent damage to the motor or the respective control circuit.

15 **Description Of The Prior Art**

The systems and methods for detecting surge current in electric motors known from the prior art usually actuate by using a predetermined current value, that is to say, a maximum current value is predetermined, so that the motor will not be damaged and, once this value is exceeded, a protection mechanism is actuated, protecting the motor or the
20 respective control circuit. However, this protection method does not enable one to differentiate whether the current rise results from a overload or from a short-circuit, causing the protection mechanism to be actuated in either situations.

Short Description Of The Invention

25 The objective of the present invention is to provide a system and a method for detecting the occurrence of surge on electric motors and its control circuit, which will enable one to distinguish the occurrence of overload on the motor from a short-circuit, by using only a current detector adjusted to a preferred limit.

30 This objective is achieved by means of a system for protecting an electric motor and its control circuit, the control of motor speed being carried out by means of a set of switches, the system comprising a control central capable of measuring the electricity conduction time of each of the switches and to measure the time passed between the begin-

ning of conduction of one of the switches and the occurrence of a surge, the central making a comparison of said times and being capable of determining whether said surge current results from a overload or from a short-circuit of the electric motor.

5 The present invention also refers to a method for protecting an electric motor and its control circuit, the speed control of which is effected by means of a set of switches, comprising a step of measuring the electricity conduction time of each of the switches, a step of measuring the time passed between the beginning of conduction of one of the switches and the occurrence of a surge current, and a step of comparing said times and consequently determining whether said surge current results from a overload or from a short-circuit on the
10 electric motor.

In addition, the present invention refers to an electric motor, the speed control of which is carried out by means of a set of switches, the control of said switches being effected by a control central that is capable of measuring the electricity conduction time of each of the switches and to measure the time passed between the beginning of conduction
15 of one of the switches and the occurrence of a surge current, the central making a comparison of the said times and being capable of determining whether said surge current results from a overload or from a short-circuit on the electric motor.

Brief Description Of The Drawings

20 The present invention will now be described in greater detail with reference to an embodiment represented in the drawings, in which:

- Figure 1 represents a schematic diagram of the speed control circuit of the motor and of the surge current detector according to the present invention;

- Figure 2 shows a temporal diagram representing the behavior of the current in a overload current situation;

25

- Figure 3 shows a temporal diagram representing the behavior of the current in a short-circuit situation;

- Figure 4 represents a flow-diagram of the method according to the present invention.

Detailed Description Of The Figures

The system for protecting an electric motor and its control circuit according to the present invention basically comprises a surge current detector 3, adjusted to a determined current limit.

5 Figure 1 schematically illustrates the motor 1 and the respective circuits for its control 2 and feeding. According to a preferred embodiment of the present invention, the motor 1 described will be of the three-phase type, which does not prevent the invention from being applied to another type of electric motor.

10 As can be seen from figure 1, the motor 1 and its control circuit 2 are fed by a source supplying alternate voltage that will be rectified by a set of diodes D and filtered by a capacitor C_1 . A set of switches Ch1 - Ch6 is responsible for the modulation of the voltage on the phases F_1 , F_2 , and F_3 of the motor 1. The control of the set of switches Ch1 - Ch6 is carried out by a control central 7.

15 The detection of surge current is carried out by means of a surge-current detecting circuit 3, which measures the current I_{RS} that flows along the circuit through the resistor R_S .

As illustrated in figure 1, the resistor R_S is installed in a position of the circuit that allows one to read the current I_M flowing through phases F_1 , F_2 , and F_3 of the motor, the current I_{RS} basically representing the current I_M .

20 The control central 7 emits commands for closing and opening the switches Ch1 - Ch6, besides receiving external information, such as the signal D_S , for instance. The signal D_S is generated by the surge current detector 3, when a predetermined I_{LIMIT} value (current limit) is exceeded.

25 The surge current detector 3 comprises an operational amplifier mounted as a voltage comparator C_O , the inlets of which are fed with voltages "E-" and "E+", wherein "E+" is the voltage of the first terminal of the resistor R_S , and "E-" is the voltage of the other terminal of this resistor R_S , plus an essentially constant voltage, defined by the voltage divider R_A and R_B . The $+V_B$ voltage is a constant.

30 The resistor R_1 causes the voltage variations on the resistor R_2 (represented by the current I_M of the motor) to be added to the constant voltage defined by the resistors R_A and R_B .

For a situation in which the current I_M flowing through the motor 1 is close to zero, the voltage "E-" is higher than the voltage "E+", thus causing the outlet D_S of the voltage comparator C_O to be at "low" level.

When the current through the motor 1 rises above a I_{LIMIT} limit defined by the resistors R_A , R_B and R_1 , the voltage in the inlet "E-" becomes lower than the voltage in the inlet corresponding to a current value beyond the admissible limit, that is to say, above the I_{LIMIT} limit, thus characterizing the detection of surge current. In this situation, the outlet of the comparator C_O passes from "low" level to "high" level, signaling the occurrence of surge current to the control central 7 by means of D_S .

The differentiation between a overload and a short-circuit is made by measuring the rise variation time of the current I_{RS} , i.e., in the event of overload, the current rise occurs gradually, taking a relatively long period of time, until the I_{LIMIT} value is reached, whereas in the cases when the motor 1 enters into short-circuit, the I_{LIMIT} value is reached much more rapidly, thus enabling one to detect this kind of failure by measuring the time.

As already known from the prior art, the speed control is carried out by means of switches Ch1 - Ch6 and, as illustrated in figures 2 and 3, the switches Ch1, Ch4 conduct electricity for a determined period of time T_c that varies depending upon the rotation speed to be imposed to the motor 1.

In order to determine whether the kind of failure on the motor 1 results from a overload or from a short-circuit, the present invention foresees the T_c -time and T_d -time measurement. The T_d -time is counted from the beginning of the conduction of the switches Ch until the moment when the current has reached the I_{LIMIT} value, that is to say, when the surge current occurred (see figures 2 and 3). The T_c -time is the time of conduction of the switches Ch and depends upon the situation of motor operation (basically speed and load).

Figures 2 and 3 represent the temporal diagrams of the situations of overload and short-circuit, respectively. By comparing the two diagrams, one can see in detail that, in the short-circuit situation, the current I_{RS} reaches the I_{LIMIT} value in much shorter T_d time when compared with the T_d time in the overload situation.

As can be seen from figure 4 schematically, the criterion used for determining whether the surge current results from a overload or from a short-circuit depends upon a relation between the T_d and T_c times. Thus, when the relation $T_d < T_c$ is true, this means that the motor 1 is in short-circuit, and when the relation is false, this means that the motor 1

has undergone a overload. The measurement of the T_d and T_c times, as well as the comparison between the respective values is carried out by means of the control central 7.

5 The value of the constant k is a fraction or portion of the T_c value (being a number between 0 and 1), and defines the limit for the distinction of the kind of failure that occurred on the motor 1, and may vary depending upon the type of motor 1 in use, in addition to the protection level to be given to the latter.

10 For instance, if the value of k is 50% (or 0.5) and if the T_d time is short (shorter than 50% of T_c), this means that the motor 1 is in short-circuit, and it is necessary to add some protection mechanism in order to avoid damage to said motor 1. In the cases when T_d is longer (longer than or equal to 50% of T_c), this means that the motor 1 has undergone a overload.

Besides enabling one to differentiate the kind of failure occurred on the motor 1 or on one of the switches Ch1 - Ch6, the present invention further enables one to estimate the value of the surge that occurred on the motor 1 by evaluating the proportion T_d/T_c .

15 A preferred embodiment of the invention having been described, it should be understood that the scope of the present invention embraces other possible variations, being limited only by the contents of the accompanying claims, the possible equivalents being included therein.

Claims

1. A system for protecting an electric motor (1) and its control circuit (2), the speed control of the motor (1) being carried out by means of a set of switches (Ch), the system being characterized by comprising a control central (7) capable of measuring the electricity conduction time (T_c) of each of the switches (Ch) and to measure the time (T_d) passed between the beginning of the conduction of one of the switches (Ch) and the occurrence of a surge, the central (7) making a comparison between said times (T_d , T_c) and being capable of determining whether said surge current results from a overload or from a short-circuit on the electric motor (1) or any of the switches (Ch).

2. A system according to claim 1, characterized in that the occurrence of a surge is detected and signaled to said central (7) by means of a surge detector (3).

3. A system according to claim 1 or 2, characterized in that the control central (7) indicates a condition of short-circuit of the motor (1) or on one of the switches (Ch) when the time (T_d) is shorter than the time (T_c) multiplied by a factor (k) that ranges from 0 to 1, the central (7) indicating a condition of surge of the motor (1) when the time (T_d) is longer than the time (T_c) multiplied by said factor (k).

4. A system according to claim 3, characterized in that said factor (k) is equal to 0.5.

5. A method for protecting an electric motor (1) and its circuit (2), the speed control of the motor (1) being carried out by means of a set of switches (Ch), the method being characterized by comprising a step of measuring the electricity conduction time (T_c) of each of the switches (Ch), a step of measuring the time (T_d) passed between the beginning of conduction of one of the switches (Ch) and the occurrence of a surge, and a step of comparing said times (T_d , T_c) and consequently determining whether said surge current results from a overload or from a short-circuit of the electric motor (1) or on any of the switches (Ch).

6. A method according to claim 5, characterized in that, in said comparison step, a condition of short-circuit of the motor (1) or on one of the switches (Ch) is indicated when

the time (T_d) is shorter than the time (T_c) multiplied by a factor (k) that ranges from 0 to 1, an overload condition of the motor (1) being indicated when the time (T_d) is longer than the time (T_c) multiplied by said factor (k).

7. A method according to claim 6, characterized in that said factor (k) is equal to

5 0.5.

8. An electric motor (1) having the speed control carried out by means of switches (Ch), the motor (1) being characterized in that the control of the switches (Ch) is carried out by a control central (7), said control central (7) being capable of measuring the electricity conduction time (T_c) of each of the switches (Ch) and to measure the time (T_d)
10 passed between the beginning of conduction of one of the switches (Ch) and the occurrence of a surge current, the central (7) making a comparison between said times (T_d , T_c) and being capable of determining whether said surge current results from a overload or from a short-circuit of said electric motor (1) or any of the switches (Ch).

9. A motor according to claim 8, characterized in that the control central (7) indicates a condition of short-circuit of the motor (1) when the time (T_d) is shorter than the time (T_c) multiplied by a factor (k) that varies between 0 and 1, the central (7) indicating a condition of overload of the motor (1) when the time (T_d) is longer than the time (T_c) multiplied by said factor (k).
15

10. A motor according to claim 9, characterized in that said factor (k) is equal to

20 0.5.

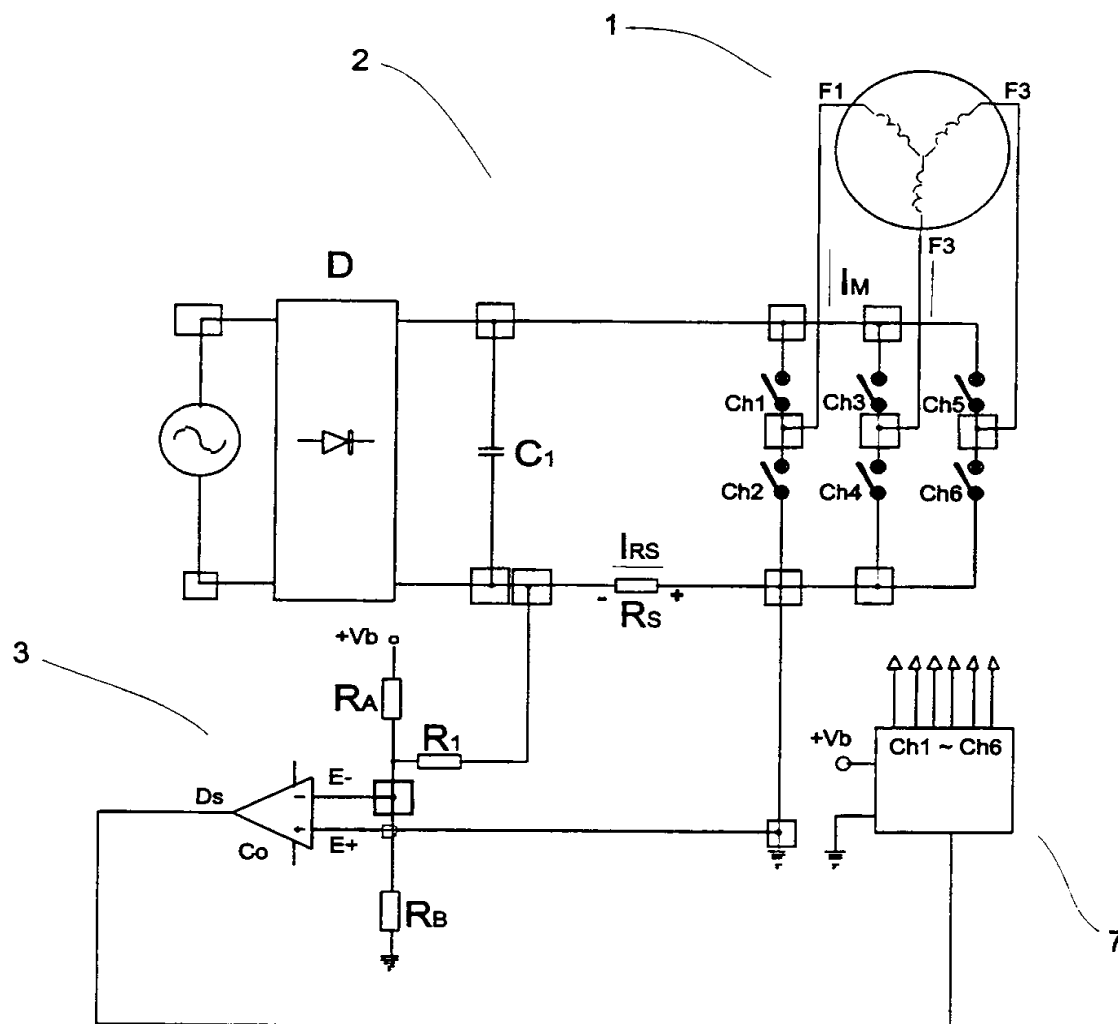


FIG. 1

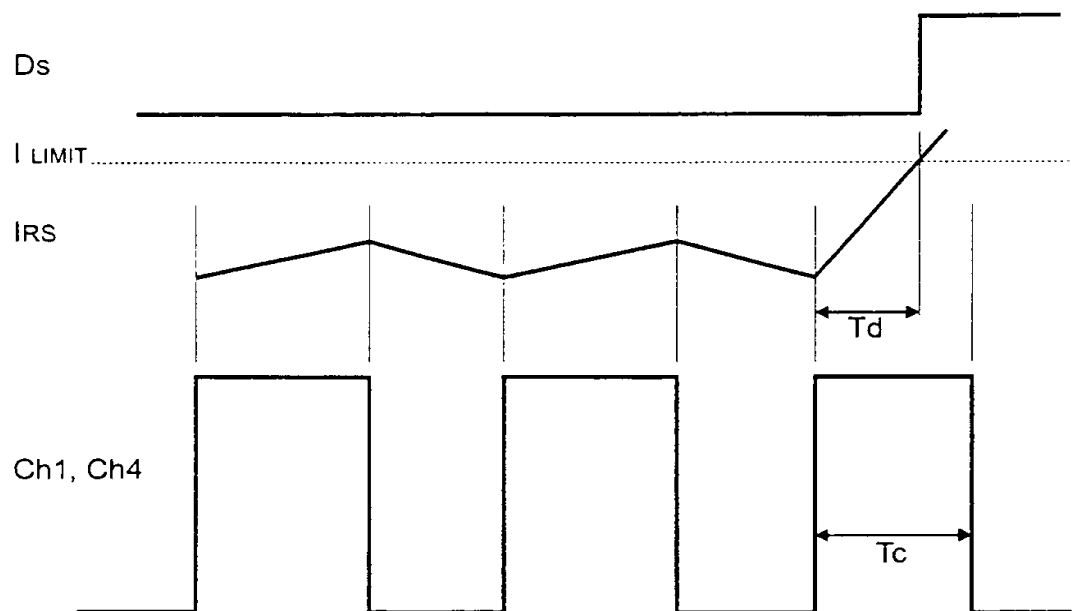


FIG. 2

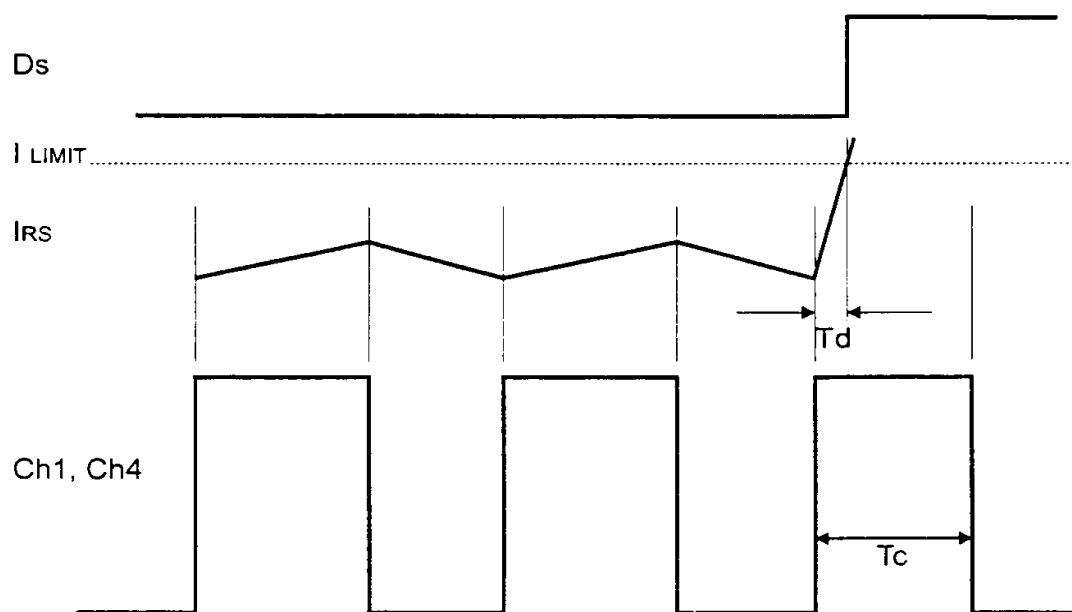


FIG. 3

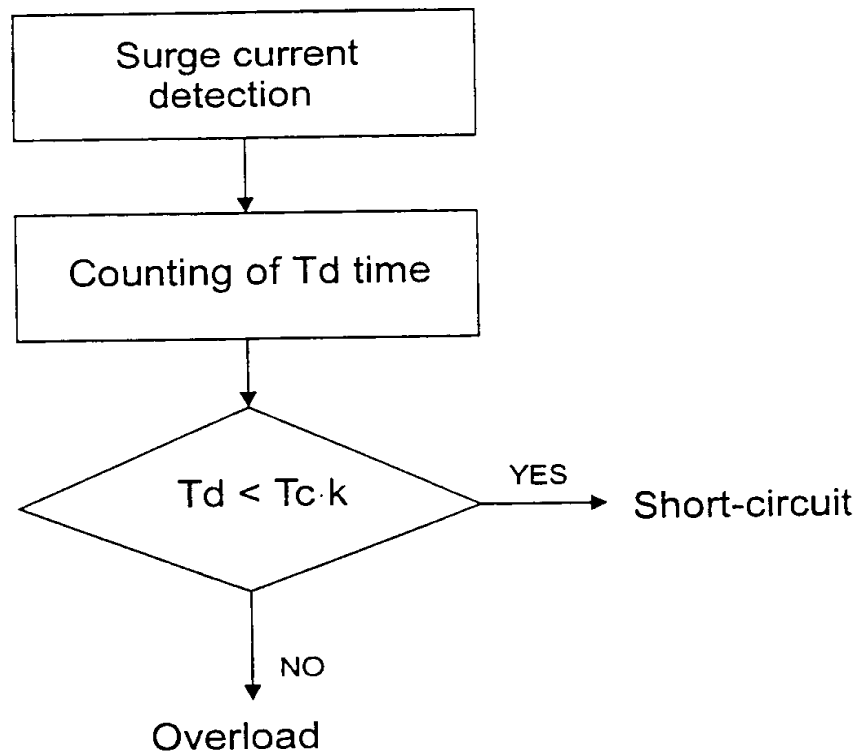


FIG. 4

PATENT COOPERATION TREATY

ver agende
12-9-00
12-10-00
1-11-00
12-11-00

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

WRITTEN OPINION
(PCT Rule 66)

To:
DANNEMANN, SIEMSEN, BIGLER &
IPANEMA MOREIRA
Rua Marques de Olinda 70, Botafogo
Caixa Postal 2142
22251-040- Rio de Janeiro - RJ
BRASIL

Applicants or agent's file reference PE-3703		Date of mailing (day/month/year) 22.08.2000
International application No. PCT/BR99/00093		REPLY DUE within 3 month(s) from the above date of mailing
International filing date (day/month/year) 11/11/1999	Priority date (day/month/year) 12/11/1998	
International Patent Classification (IPC) or both national classification and IPC H02H7/08		
Applicant EMPRESA BRASILEIRA DE COMPRESSORES S.A. et al.		

1. This written opinion is the first drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement
- VI ☐ Certain document cited
- VII ☒ Certain defects in the International application
- VIII ☒ Certain observations on the International application

3. The applicant is hereby invited to reply to this opinion.


When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4. For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis. For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 12/03/2001.

Name and mailing address of the international preliminary examining authority:

European Patent Office
D-80299 Munich
Tel. +49 89 23699 - 0 Tx: 523656 eomu d
Fax: +49 89 23699 - 4485

Authorized officer / Examiner

Kern, H

Former/les officer (incl. extension of time limits)
Schuster-Kaechele, W
Telephone No. +49 89 2330 2281



Frank

WRITTEN OPINION

International application No. PCT/BR99/00093

I. Basis of the opinion

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*).

Description, pages:

1-8 as originally filed

Claims, No.:

1-10 as originally filed

Drawings, sheets:

1/3-3/3 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Rule 66.2(a)(II) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims
Inventive step (IS)	Claims
Industrial applicability (IA)	Claims

2. Citations and explanations

see separate sheet

WRITTEN OPINION

International application No. PCT/BR99/00093

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

**WRITTEN OPINION
SEPARATE SHEET**

International application No. PCT/BR99/00093

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. This report will make reference to the documents cited in the International Search Report which will be referenced as D1 to D7 according to their sequence of citation.
2. The subject-matter of the application as can be derived from claim 1 in combination with the description appears to be a protection circuit for an inverter fed electrical motor whereby the motor current is detected in the DC lines of the inverter and depending on the detected rise time a current surge is detected. According to the different measured time rise compared to the conduction time of the inverter switches overcurrent or short circuit is detected.

The document D2 discloses an inverter fed electrical motor detecting the motor current in DC lines of the inverter which has the same topology as present application. The detection of the motor current in the DC lines is used for controlling purposes of the motor. An evaluation of the measured motor current in order to detect an overcurrent and to execute a protection operation is not foreseen in prior art document D2. The other documents cited in the search report which deal with protection measures (e.g. document D1: GB-A-2 267 190) do not evaluate the time rise of an overcurrent. Therefore it appears in the examiner's preliminary opinion that with respect to the available state of the art, the present protection circuit can not be derived from prior art and that therefore the disclosed subject-matter can meet the requirements of the PCT.

Re Item VII

Certain defects in the international application

To meet the requirements of Rule 5.1 a) II) PCT the relevant background art disclosed in the documents D1, D2 should be mentioned in the description and these documents should be identified therein. ✓

**WRITTEN OPINION
SEPARATE SHEET**

International application No. PCT/BR99/00093

Re Item VIII**Certain observations on the international application**

Concerning the independent claims 1,5,8 the following observations are made. Claims 1 and 8 concern apparatus claims of overlapping scope which are distinguished by minor different wording and these claims are not concise. There are no reasons why the underlying matter could not be covered by one independent claim.

Further, claim 1 refers to "a system for protecting an electric motor and its control circuit.." whereby by the factitive use of "for" it is unclear if the motor and the control circuit belong to the claimed matter. A more precise wording could be drafted as "a protection circuit (or device) comprising an electric motor and its control circuit..". Considering document D2 as closest prior art then in a new drafted claim 1 the preamble should concretely specify the common features with D2 (e.g. inverter fed electric motor; the concrete detection of the current etc.).

Also the feature in present claim "measuring the electricity conduction time of each of the switches " appears imprecise and not supported in the description. So far as the examiner feels able to understand the application the present protection circuit uses that time (Tc) which is available in the control circuit for gating the switches, which corresponds only vaguely to the real conduction time of the switches embodied as thyristors or transistors. Further the term "occurrence of a surge" is vague and imprecise as the description merely discloses the possibility to detect a surge as a current which exceeds a particular current limit.

Further proceedings

The applicant is asked to file a new set of claims with at least one independent claim in each category and drafted in the form as required by Rule 6.3, 6.4 PCT.

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

PCT/BR 99 / 00093

For receiving Office use only

PCT/BR 99 / 00093

International Application No.

11 NOV 1999 11 -11 99
International Filing DateINPI/BRAZIL-PCT INTERNATIONAL APPLICATION
Name of receiving Office and "PCT International Application"Applicant's or agent's file reference
(if desired) (12 characters maximum) PE-3703

Box No. I TITLE OF INVENTION
"A SYSTEM AND A METHOD FOR PROTECTION AND ELECTRIC MOTOR AND ITS CONTROL CIRCUIT, AND AN ELECTRIC MOTOR"

Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

EMPRESA BRASILEIRA DE COMPRESSORES S.A. -
EMBRACO
Rua Rui Barbosa, 1020
89219-901 - Joinville - SC
Brazil

☐ This person is also inventor.

Telephone No.
(47) 441-2548

Facsimile No.
(47) 441-2740

Teleprinter No.

State (that is, country) of nationality:

BR

State (that is, country) of residence:

BR

This person is applicant
for the purposes of:

☐ all designated
States

☒ all designated States except
the United States of America

☐ the United States
of America only

☐ the States indicated in
the Supplemental Box
Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

SCHWARZ, MARCOS GUILHERME
Rua General Osório - Conjunto Belvedere 2
Joinville - Santa Catarina
Brazil

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only (If this check-box
is marked, do not fill in below.)

State (that is, country) of nationality:

BR

State (that is, country) of residence:

BR

This person is applicant
for the purposes of:

☐ all designated
States

☐ all designated States except
the United States of America

☒ the United States
of America only

☐ the States indicated in
the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf
of the applicant(s) before the competent International Authorities as:

☒ agent

☐ common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

DANNEMANN, SIEMSEN, BIGLER & IPANEMA MOREIRA
Caixa Postal 2142
Rua Marquês de Olinda, 70
Botafogo
22251-040 - Rio de Janeiro - RJ
Brazil

Telephone No.

(21) 553.1811

Facsimile No.

(21) 553.1812
553.1813

Teleprinter No.

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

DAINEZ, PAULO SÉRGIO
Rua Rui Barbosa, 1431, apt. 302, Bloco I
Joinville - Santa Catarina
Brazil

This person is:

- ☐ applicant only
☒ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

BR

State (that is, country) of residence:

BR

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

- ☐ applicant only
☐ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

- ☐ applicant only
☐ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

- ☐ applicant only
☐ applicant and inventor
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:

- ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes: at least one must be marked)

Regional Patent

- ☐ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☐ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☐ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|---|---|
| <input type="checkbox"/> AE United Arab Emirates | <input type="checkbox"/> LR Liberia |
| <input type="checkbox"/> AL Albania | <input type="checkbox"/> LS Lesotho |
| <input type="checkbox"/> AM Armenia | <input type="checkbox"/> LT Lithuania |
| <input type="checkbox"/> AT Austria | <input type="checkbox"/> LU Luxembourg |
| <input type="checkbox"/> AU Australia | <input type="checkbox"/> LV Latvia |
| <input type="checkbox"/> AZ Azerbaijan | <input type="checkbox"/> MD Republic of Moldova |
| <input type="checkbox"/> BA Bosnia and Herzegovina | <input type="checkbox"/> MG Madagascar |
| <input type="checkbox"/> BB Barbados | <input type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input type="checkbox"/> BG Bulgaria | |
| <input type="checkbox"/> BR Brazil | <input type="checkbox"/> MN Mongolia |
| <input type="checkbox"/> BY Belarus | <input type="checkbox"/> MW Malawi |
| <input type="checkbox"/> CA Canada | <input type="checkbox"/> MX Mexico |
| <input type="checkbox"/> CH and LI Switzerland and Liechtenstein | <input type="checkbox"/> NO Norway |
| <input checked="" type="checkbox"/> CN China | <input type="checkbox"/> NZ New Zealand |
| <input type="checkbox"/> CU Cuba | <input type="checkbox"/> PL Poland |
| <input type="checkbox"/> CZ Czech Republic | <input type="checkbox"/> PT Portugal |
| <input type="checkbox"/> DE Germany | <input type="checkbox"/> RO Romania |
| <input type="checkbox"/> DK Denmark | <input type="checkbox"/> RU Russian Federation |
| <input type="checkbox"/> EE Estonia | <input type="checkbox"/> SD Sudan |
| <input type="checkbox"/> ES Spain | <input type="checkbox"/> SE Sweden |
| <input type="checkbox"/> FI Finland | <input checked="" type="checkbox"/> SG Singapore |
| <input type="checkbox"/> GB United Kingdom | <input type="checkbox"/> SI Slovenia |
| <input type="checkbox"/> GD Grenada | <input type="checkbox"/> SK Slovakia |
| <input type="checkbox"/> GE Georgia | <input type="checkbox"/> SL Sierra Leone |
| <input type="checkbox"/> GH Ghana | <input type="checkbox"/> TJ Tajikistan |
| <input type="checkbox"/> GM Gambia | <input type="checkbox"/> TM Turkmenistan |
| <input type="checkbox"/> HR Croatia | <input checked="" type="checkbox"/> TR Turkey |
| <input type="checkbox"/> HU Hungary | <input type="checkbox"/> TT Trinidad and Tobago |
| <input type="checkbox"/> ID Indonesia | <input type="checkbox"/> UA Ukraine |
| <input type="checkbox"/> IL Israel | <input type="checkbox"/> UG Uganda |
| <input type="checkbox"/> IN India | <input checked="" type="checkbox"/> US United States of America |
| <input type="checkbox"/> IS Iceland | |
| <input checked="" type="checkbox"/> JP Japan | <input type="checkbox"/> UZ Uzbekistan |
| <input type="checkbox"/> KE Kenya | <input type="checkbox"/> VN Viet Nam |
| <input type="checkbox"/> KG Kyrgyzstan | <input type="checkbox"/> YU Yugoslavia |
| <input type="checkbox"/> KP Democratic People's Republic of Korea | <input type="checkbox"/> ZA South Africa |
| | <input type="checkbox"/> ZW Zimbabwe |
| <input checked="" type="checkbox"/> KR Republic of Korea | |
| <input type="checkbox"/> KZ Kazakhstan | |
| <input type="checkbox"/> LC Saint Lucia | |
| <input type="checkbox"/> LK Sri Lanka | |

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

- ☐
- ☐

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

☐ Further priority claims are indicated in the Supplemental Box

Box No. VI PRIORITY CLAIM

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 12 November 1998 (12.11.98)	PI 9804608-0	BR		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): 01

* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

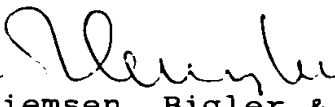
Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):	Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):		
ISA/ EPO	Date (day/month/year)	Number	Country (or regional Office)

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:		This international application is accompanied by the item(s) marked below:	
request	: 4	1.	<input checked="" type="checkbox"/> fee calculation sheet
description (excluding sequence listing part)	: 6	2.	<input checked="" type="checkbox"/> separate signed power of attorney
claims	: 2	3.	<input type="checkbox"/> copy of general power of attorney; reference number, if any:
abstract	: 1	4.	<input type="checkbox"/> statement explaining lack of signature
drawings	: 3	5.	<input type="checkbox"/> priority document(s) identified in Box No. VI as item(s):
sequence listing part of description	: —	6.	<input type="checkbox"/> translation of international application into (language):
Total number of sheets : 16		7.	<input type="checkbox"/> separate indications concerning deposited microorganism or other biological material
		8.	<input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form
		9.	<input checked="" type="checkbox"/> other (specify): inventors' assignment
Figure of the drawings which should accompany the abstract: 1		Language of filing of the international application: English	

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).


Dannemann, Siemsen, Bigler & Ipanema Moreira

For receiving Office use only

1. Date of actual receipt of the purported international application: 11 NOV 1999 11-11 99	2. Drawings:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	<input type="checkbox"/> received:
4. Date of timely receipt of the required corrections under PCT Article 11(2):	<input type="checkbox"/> not received:
5. International Searching Authority (if two or more are competent): ISA /	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

PCT

FEE CALCULATION SHEET

Annex to the Request

For receiving Office use only

PCT/BR 99 / 00093

International application No.

Applicant's or agent's
file reference

PE-3703

Date stamp of the receiving Office

Applicant **EMPRESA BRASILEIRA DE COMPRESSORES S.A - EMBRACO,
SCHWARZ, MARCOS GUILHERME and DAINEZ, PAULO SÉRGIO**

CALCULATION OF PRESCRIBED FEES

- | | | |
|---------------------------------|------------|---|
| 1. TRANSMITTAL FEE | R\$ 236,00 | T |
| 2. SEARCH FEE DM 550 x 1.034970 | R\$ 569,23 | S |

International search to be carried out by EPO

(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

Basic Fee

The international application contains 16 sheets.

first 30 sheets CHF 650x1.257320 = R\$ 817,25 **b1**

remaining sheets x additional amount = **b2**

Add amounts entered at b1 and b2 and enter total at B R\$ 817,25 **B**

Designation Fees

The international application contains 7 designations.

7 x CHF 150x1.257320 = R\$ 1.320,18 **D**

number of designation fees payable (maximum 10) amount of designation fee

Add amounts entered at B and D and enter total at I R\$ 2.137,43 **I**

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

- | | | |
|--|-----------|---|
| 4. FEE FOR PRIORITY DOCUMENT (if applicable) | R\$ 75,00 | P |
|--|-----------|---|

- | | |
|-----------------------|--------------|
| 5. TOTAL FEES PAYABLE | R\$ 3.017,66 |
|-----------------------|--------------|

Add amounts entered at T, S, I and P, and enter total in the TOTAL box

TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☐ authorization to charge
deposit account (see below)

☐ cheque

☐ postal money order

☐ bank draft

☒ cash

☐ revenue stamps

☐ coupons

☐ other (specify):

DEPOSIT ACCOUNT AUTHORIZATION (this mode of payment may not be available at all receiving Offices)

The RO/ ☐ is hereby authorized to charge the total fees indicated above to my deposit account.

☐ (this check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit) is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

☐ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

Deposit Account No.

Date (day/month/year)

Signature

The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below

IPEA/ EPO

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:

The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA		Date of receipt of DEMAND	
Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION		Applicant's or agent's file reference PE-3703	
International application No. PCT/BR99/00093	International filing date (day/month/year) 11 November 1999 (11.11.99)	(Earliest) Priority date (day/month/year) 12 November 1998 (12.11.98)	
Title of invention "A system and a method for protection and electric motor and its control circuit, and an electric motor"			
Box No. II APPLICANT(S)			
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) EMPRESA BRASILEIRA DE COMPRESSORES S.A. - EMBRACO Rua Rui Barbosa, 1020 89219-901 - Joinville - SC Brazil		Telephone No.: (47) 441-2548	
		Facsimile No.: (47) 441-2740	
		Teleprinter No.:	
State (that is, country) of nationality: BR		State (that is, country) of residence: BR	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) SCHWARZ, MARCOS GUILHERME Rua General Osório - Conjunto Belvedere 2 Joinville - Santa Catarina Brazil			
State (that is, country) of nationality: BR		State (that is, country) of residence: BR	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) DAINEZ, PAULO SÉRGIO Rua Rui Barbosa, 1431, apt. 302, Bloco I Joinville - Santa Catarina Brazil			
State (that is, country) of nationality: BR		State (that is, country) of residence: BR	
<input type="checkbox"/> Further applicants are indicated on a continuation sheet.			

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCEThe following person is ☒ agent ☐ common representativeand ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*DANNEMANN, SIEMSEN, BIGLER & IPANEMA MOREIRA
Caixa Postal 2142
Rua Marquês de Olinda, 70
Botafogo
22251-040 - Rio de Janeiro - RJ
Brazil

Telephone No.:

(5521) 553.1811

Facsimile No.:

(5521) 553-1812
553-1813

Teleprinter No.:

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.**Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION****Statement concerning amendments:***

1. The applicant wishes the international preliminary examination to start on the basis of:

☒ the international application as originally filedthe description ☒ as originally filed
☐ as amended under Article 34the claims ☒ as originally filed
☐ as amended under Article 19 (together with any accompanying statement)
☐ as amended under Article 34the drawings ☒ as originally filed
☐ as amended under Article 342. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.3. ☐ The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English☒ which is the language in which the international application was filed.☐ which is the language of a translation furnished for the purposes of international search.☐ which is the language of publication of the international application.☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.**Box No. V ELECTION OF STATES**The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

- | | | |
|--|---|--------|
| 1. translation of international application | : | sheets |
| 2. amendments under Article 34 | : | sheets |
| 3. copy (or, where required, translation) of amendments under Article 19 | : | sheets |
| 4. copy (or, where required, translation) of statement under Article 19 | : | sheets |
| 5. letter | : | sheets |
| 6. other (<i>specify</i>) | : | sheets |

For International Preliminary Examining Authority use only

received not received

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

The demand is also accompanied by the item(s) marked below:

- | | |
|--|---|
| 1. <input checked="" type="checkbox"/> fee calculation sheet | 4. <input type="checkbox"/> statement explaining lack of signature |
| 2. <input type="checkbox"/> separate signed power of attorney | 5. <input type="checkbox"/> nucleotide and or amino acid sequence listing in computer readable form |
| 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: | 6. <input type="checkbox"/> other (<i>specify</i>): |

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).


Dannemann, Siemsen, Bigler & Ipanema Moreira

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply.

☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

PCT

FEE CALCULATION SHEET

Annex to the Demand for international preliminary examination

International application No. PCT/BR99/00093	For International Preliminary Examining Authority use only	
Applicant's or agent's file reference PE-3703	Date stamp of the IPEA	
Applicant EMPRESA BRASILEIRA DE COMPRESSORES S.A. - EMBRACO at al		
Calculation of prescribed fees		
1. Preliminary examination fee	DEM 749.58	<input type="checkbox"/> P
2. Handling fee (<i>Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.</i>)	DEM 287.51	<input type="checkbox"/> H
3. Total of prescribed fees Add the amounts entered at P and H and enter total in the TOTAL box	DEM 1.037.09	
TOTAL		
Mode of Payment		
<input type="checkbox"/> authorization to charge deposit account with the IPEA (see below)	<input type="checkbox"/> cash	
<input type="checkbox"/> cheque	<input type="checkbox"/> revenue stamps	
<input type="checkbox"/> postal money order	<input type="checkbox"/> coupons	
<input checked="" type="checkbox"/> bank draft	<input type="checkbox"/> other (specify):	
Deposit Account Authorization (<i>this mode of payment may not be available at all IPEAs</i>)		
The IPEA/ _____ <input type="checkbox"/> is hereby authorized to charge the total fees indicated above to my deposit account.		
<input type="checkbox"/> (<i>this check-box may be marked only if the conditions for deposit accounts of the IPEA so permit</i>) is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.		
Deposit Account Number _____	Date (day/month/year) _____	Signature _____

DANNEMANN SIEMSEN BIGLER & IPANEMA MOREIRA

PROPRIEDADE INDUSTRIAL

PCT Chapter II

EDUARDO DANNEMANN (1919 - 1959)
CATHARINA BIGLER (1947 - 1981)

CARL BUSCHMANN (1900 - 1941)
UIZ DE IPANEMA MOREIRA (1927 - 1990)

EGLINDE TIEDEMANN BARRETO (CONS)
SAMIR SAID MATHEUS (CONS)

PETER DIRK SIEMSEN
GERT EGON DANNEMANN
DAVID MERRYLEES
GISELA FISCHER O. COSTA
MANOEL PESTANA DA SILVA NETTO
JOSE ANTONIO B. L. FARIA CORREA
LUIZ HENRIQUE O. DO AMARAL
MARIA THEREZA M. WOLFF

RAUL HEY
CARLOS CEZAR CORDEIRO PIRES
LUIZ ANTONIO DE CARVALHO
* GUSTAVO DE FREITAS MORAIS
IVAN BACELLAR AHLERT
MARIA CARMEN DE SOUZA BRITO
ANA LUCIA DE SOUSA BORDA
* HENRIQUE STEUER I. DE MELLO
PETER EDUARDO SIEMSEN
ELISABETH SIEMSEN
CARLA TIEDEMANN C. BARRETO
ATTILIO JOSE VENTURA GORINI
A. WEBER N. MILAGRE
TANNAY DE FARIAS
JOSE EDUARDO CAMPOS VIEIRA
JORGE KNAUSS DE MENDONÇA
SEMIR DA SILVA FONSECA
ALVARO LOUREIRO OLIVEIRA
* RAFAELA BORGES WALTER

* LUIZ GONZAGA M. LOBATO

MARIA EDINA DE O. C. PORTINARI
ALEXANDRE PEIXOTO L. MAIA
MARCOS VELASCO FIGUEIREDO
JOSE CARLOS VAZ E DIAS
RODRIGO BORGES CARNEIRO
RENATA HOHL
ROGER CHARLES TAYLOR TROTH
PAULO DE TARSO CASTRO BRANDÃO
JOAQUIM EUGENIO GOULART
MAURO IVAN C. R. DOS SANTOS
* MARINA INÉS FUZITA KARAKANIAN

* FRANK FISCHER
MANUELA ROMANA GOMES CARNEIRO
MARCIA DE OLIVEIRA ANECHINNO
JOSE HENRIQUE VASI WERNER
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SYDINEA DE SOUZA TRINDADE
SANDRA LEIS
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* SANDRA BRANDAO DE ABREU
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JANSEN GAVA MOREIRA VIANA
* VERENA FISCHER
* ROBERTA X. DA S. CALAZANS
* EMILIA MARGUEIRO CAMPOS
RODRIGO ROCHA DE SOUZA

RODOLPHO GEORG
PAULO ROBERTO DIAMANTE

MARKUS MICHAEL DE M. WOLFF (cons.tec.)
MARCO ANTONIO GONÇALVES (cons.tec.)
JOSE MARCELO O. FERNANDES (cons.tec.)
AURICIO TEIXEIRA D. DA SILVA (cons.tec.)

RIO DE JANEIRO

RUA MARQUÊS DE OLINDA, 70
22251-040 RIO DE JANEIRO - RJ
BRASIL
TELEFONE (21) 553 1811
TELEFAX (21) 553 1812
(21) 553 1813
mail@dannemann.com.br
TELEGRAMA ROBDAN BR

C. POSTAL (P.O. BOX) 2142
20001-970 RIO DE JANEIRO - RJ
BRASIL

* SÃO PAULO

AV. INDIANÓPOLIS, 739
04063-000 SÃO PAULO - SP
BRASIL
TELEFONE (11) 5575 2024
TELEFAX (11) 5549 2300
sprmail@dannemann.com.br

C. POSTAL (P.O. BOX) 57065
04093-970 SÃO PAULO - SP
BRASIL

Agente da Propriedade Industrial
Registro n° 192

Associado a A B A P I

PE 3703 epo.doc

FAX
311100

Code: 311878002

EUROPEAN PATENT OFFICE
Erhardstrasse 27
D-80298 München
DE-Alemanha

Att.: Kern, H.
Authorised officer/Examiner

São Paulo, November 13, 2000

Fax.: 0049 89 2399 4465
(fax and air courier)

Ref.: PCT - International Patent Application PCT/BR99/00093
filed on November 11, 1999
Reply to the first written opinion
EMPRESA BRASILEIRA DE COMPRESSORES S.A. - EMBRACO
Our ref.: PE-3703 (ffi)

Dear Sirs,

In reply to the first written opinion mailed on August 22, 2000, the applicant offers the following comments with respect to section V, items V, VII and VIII thereof.

Re item V

None of the prior art documents disclose a system nor a method to protect an electric motor and its control circuit, said solution monitoring the time of the conduction of the switches used to feed the motor, and simultaneously monitoring the occurrence (and the time of the occurrence) of a surge current. By using this approach it is possible conclude if a rise of the electric current is result of an overload or a result of a short-circuit and prevent the damage of the motor or its control circuit. Therefore, the applicant believes that the present invention is patentable in the light of the prior art.

Re item VII

A brief discussion of the relevant prior art disclosed in the documents GB 2 267 190 and US 4 558 264 has been included in the specification to meet the requirements of Rule 5.1 a) ii) of the PCT.

Re item VIII

Claim 1 has been amended to recite more clearly the characteristics of the present invention, and to include the common features with D2 in the preamble i.e. a control circuit including a set of switches to control the speed of an electric motor.

The applicant has not excluded the phrasing using the word "for", since the suggested phrase would not define the invention correctly. In this sense, the applicant has the following comments: The present invention is a system that will protect simultaneously a combination of an electric motor and its control circuit. The motor and said control circuit are not the object of the present invention and, according to the present invention, it is possible to protect any motor that is fed by a set of switches. The first paragraph of the specification has been amended to clarify this issue.

Referring to the phrase "measuring the electricity conduction time...", the applicant understands that it is supported in the description (see first paragraph of page 3 of the

DANNEMANN SIEMSEN BIGLER & IPANEMA MOREIRA



PROPRIEDADE INDUSTRIAL

EDUARDO DANNEMANN (1919 - 1959)
CATHARINA BIGLER (1947 - 1981)

CARL BUSCHMANN (1900 - 1941)
LUIZ DE IPANEMA MOREIRA (1927 - 1990)

GLINDE TIEDEMANN BARRETO (CONS)
SAMIR SAID MATHEUS (CONS)

PETER DIRK SIEMSEN
GERT EGON DANNEMANN
DAVID MERRYLEES
GISELA FISCHER O. TOSTA
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LUIZ HENRIQUE O. DO AMARAL
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RAUL HEY
CARLOS CEZAR CORDEIRO PIRES
LUIZ ANTONIO DE CARVALHO
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IVAN BACELLAR AHLERT
MARIA CARMEN DE SOUZA BRITO
ANA LUCIA DE SOUSA BORDA
* HENRIQUE STEUER I. DE MELLO
PETER EDUARDO SIEMSEN
ELISABETH SIEMSEN
CARLA TIEDEMANN C. BARRETO
ATTILIO JOSE VENTURA GORINI
A. WEBER N. MILAGRE
TANNAY DE FARIAS
JOSE EDUARDO CAMPOS VIEIRA
JORGE KNAUSS DE MENDONÇA
SEMIR DA SILVA FONSECA
ALVARO LOUREIRO OLIVEIRA
* RAFAELA BORGES WALTER

* LUIZ GONZAGA M. LOBATO

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ALEXANDRE PEIXOTO L. MAIA
MARCOS VELASCO FIGUEIREDO
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RODRIGO BORGES CARNEIRO
RENATA HOHL
ROGER CHARLES TAYLOR TROTTH
PAULO DE TARSO CASTRO BRANDÃO
JOAQUIM EUGENIO GOULART
MAURO IVAN C. R. DOS SANTOS
* MARINA INÊS FUZITA KARAKANIAN
* FRANK FISCHER
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JUSSARA TOLENTINO N. TRINDADE
ALEXANDER B. CORREIA
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RIO DE JANEIRO

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22251-040 RIO DE JANEIRO - RJ
BRASIL
TELEFONE (21) 553 1811
TELEFAX (21) 553 1812
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mail@dannemann.com.br
TELEGRAMA ROBIDAN

C. POSTAL (P.O. BOX) 2142
20001-970 RIO DE JANEIRO - RJ
BRASIL

* SÃO PAULO

AV. INDIANÓPOLIS, 739
04063-000 SÃO PAULO - SP
BRASIL
TELEFONE (11) 5575 2024
TELEFAX (11) 5549 2300
spmail@dannemann.com.br

C. POSTAL (P.O. BOX) 57065
04093-970 SÃO PAULO - SP
BRASIL

Agente da Propriedade Industrial
Registro nº 192

Associado a A B A P I

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amended specification). The applicant also believes that by reading the specification (see line 18-20, page 1; line 9-13, page 4; line 15-18, page 5 of the amended specification; and figures 1-3) a person skilled in the art would be able to understand that the switches Ch conduct electricity for a certain time. Further, in fact the conduction time of a thyristor or a transistor is different than a theoretic conduction time, but the applicant believes that a person skilled in the art would be able to preview these differences and make the necessary adjustments.

The problem referring to the vagueness of the "occurrence of a surge", has been corrected by amending the claim.

Further, the applicant has amended the other independent claims to recite more clearly the characteristics of the present invention and to protect different aspects of the present invention.

Finally, the specification has been amended on page 4, lines 14-17 and page 5, line 19 to describe more clearly the invention. The applicant observes that these amendments do not include new matter to the specification.

In view of the above comments, applicant files herewith new pages 1-6 of the specification and claims and now awaits receipt of a favourable international preliminary report.

Very truly yours,

Frank Fischer
(Agent for the applicant)

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

DANNEMANN, SIEMSEN, BIGLER &
IPANEMA MOREIRA
Rua Marques de Olinda 70, Botafogo
Caixa Postal 2142
22251-040- Rio de Janeiro - RJ
BRESIL

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

15911213

Date of mailing
(day/month/year)

Applicant's or agent's file reference
PE-3703

IMPORTANT NOTIFICATION

International application No.
PCT/BR99/00093

International filing date (day/month/year)
11/11/1999

Priority date (day/month/year)
12/11/1998

Applicant

EMPRESA BRASILEIRA DE COMPRESSORES S.A....et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer

Garvey, R

Tel. +49 89 2399-2271



PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL SEARCHING AUTHORITY

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

(PCT Rule 44.1)

To:
DANNEMANN, SIEMSEN, BIGLER &
IPANEMA MOREIRA
Caixa Postal 2142
22251-040- Rio de Janeiro - RJ
BRAZIL

Date of mailing
(day/month/year) 05/06/2000

Applicant's or agent's file reference
PE-3703

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.
PCT/ BR 99/ 00093

International filing date
(day/month/year) 11/11/1999

Applicant

EMPRESA BRASILEIRA DE COMPRESSORES S.A....et al.

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Gregory Adam

Gustavo

DANNEMANN, SIEMSEN
IPANEMA MOREIRA

12 JUN 16 5 0 00

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments and any accompanying statement, under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the time of filing the amendments (and any statement) with the International Bureau, also file with the International Preliminary Examining Authority a copy of such amendments (and of any statement) and, where required, a translation of such amendments for the procedure before that Authority (see Rules 55.3(a) and 62.2, first sentence). For further information, see the Notes to the demand form (PCT/IPEA/401).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference PE-3703	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/BR 99/ 00093	International filing date (day/month/year) 11/11/1999	(Earliest) Priority Date (day/month/year) 12/11/1998
Applicant EMPRESA BRASILEIRA DE COMPRESSORES S.A....et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

A SYSTEM AND A METHOD FOR PROTECTING AN ELECTRIC MOTOR AND ITS CONTROL CIRCUIT AND AN ELECTRIC MOTOR

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1
☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/BR 99/00093

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H02H 7/08, H02P 7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H02H, H02P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2267190 A (INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE), 24 November 1993 (24.11.93), abstract --	1-10
A	US 4558264 A (R.WEISCHEDEL), 10 December 1985 (10.12.85), abstract --	1-10
A	US 5008608 A (P.J.UNSWORTH ET AL), 16 April 1991 (16.04.91), abstract --	1-10
A	CH 629628 A5 (BUGNION S.A.), 30 April 1982 (30.04.82), abstract --	1-10

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

5 April 2000

Date of mailing of the international search report

05.06.00

Name and mailing address of the International Searching Authority
European Patent Office P B 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel(+31-70)340-2040, Tx 31 651 epo nl
Fax(+31-70)340-3016

Authorized officer

Lars Jakobsson /itw
Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR 99/00093

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 3338764 A1 (ROBERT BOSCH GMBH), 9 May 1985 (09.05.85), abstract --	1-10
A	US 4494163 A (C.YELLAND ET AL), 15 January 1985 (15.01.85), abstract --	1-10
A	US 5703768 A (S.KANNA ET AL), 30 December 1997 (30.12.97), abstract -- -----	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.
PCT/BR 99/00093

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
GB	2267190	A	24/11/93	NONE	
US	4558264	A	10/12/85	CA 1228640 A	27/10/87
US	5008608	A	16/04/91	CA 2028476 A	27/06/91
				DE 69021187 D,T	04/04/96
				EP 0435038 A,B	03/07/91
				JP 3173374 A	26/07/91
				MX 164426 B	12/08/92
CH	629628	A5	30/04/82	NONE	
DE	3338764	A1	09/05/85	NONE	
US	4494163	A	15/01/85	AT 17807 T	15/02/86
				AU 563386 B	09/07/87
				AU 8651082 A	10/02/83
				CA 1194539 A	01/10/85
				EP 0072146 A,B	16/02/83
				JP 58049041 A	23/03/83
				ZA 8205955 A	29/06/83
US	5703768	A	30/12/97	CN 1038173 B	22/04/98
				CN 1138245 A	18/12/96
				EP 0734114 A	25/09/96
				JP 8331882 A	13/12/96